

CLAIMS

1. Reinforced ply material comprising an elastomeric sheet and a plurality of reinforcement elements embedded therein;
wherein the reinforcement elements are grouped in untwisted sets and each set contains a plurality of reinforcement elements;
wherein adjacent reinforcement elements in the same set are spaced apart an intra-set distance and adjacent reinforcement elements in different sets are spaced apart an inter-set distance; and
wherein the inter-set distance is greater than the intra-set distance.

10 2. Reinforced ply material as set forth in claim 1, wherein the intra-set distance is substantially the same between the reinforcement elements.

15 3. Reinforced ply material as set forth in claim 1, wherein the inter-set distance is substantially the same between the sets of reinforcement elements.

4. Reinforced ply material as set forth in claim 1, wherein the reinforcement elements are positioned in a single planar row.

5. Reinforced ply material as set forth in claim 1, wherein each set contains the same number of reinforcement elements.

6. Reinforced ply material as set forth in claim 1, wherein the reinforcement elements are steel monofilaments.

20 7. Reinforced ply material as set forth in claim 6, wherein the intra-set distance is substantially the same between the reinforcement elements, wherein the inter-set distance is substantially the same between the sets of reinforcement elements, wherein the reinforcement elements are positioned in a single planar

row, and wherein each set contains the same number of reinforcement elements.

8. Reinforced ply material as set forth in claim 6, comprising between about 100 and about 220 sets of reinforcement elements, wherein each set comprises between 2 and 8 reinforcement elements, and wherein each reinforcement element has a diameter of about 0.20 mm to about 0.30 mm.

9. Reinforced ply material as set forth in claim 8, comprising between about 150 and about 170 sets of reinforcement elements, wherein each set comprises 3 reinforcement elements, and wherein each reinforcement element has a diameter of about 0.25 mm to about 0.26 mm.

10. Reinforced ply material as set forth in claim 6, wherein the intra-set distance is between about 0.00 mm and about 0.30 mm and wherein the inter-set distance is between about 0.25 mm and about 0.50 mm.

11. Reinforced ply material as set forth in claim 10, wherein the intra-set distance is between about 0.00 mm and about 0.20 mm and wherein the inter-set distance is between about 0.10 mm and 0.50 mm.

12. Reinforced ply material as set forth in claim 11, wherein the intra-set distance is about 0.00 mm.

13. Reinforced ply material as set forth in claim 11, wherein the inter-set distance is between about 0.30 mm and 0.50 mm.

14. Reinforced ply material as set forth in claim 1, wherein the elastomeric sheet is made of rubber.

15. A steel belt made from the reinforced ply material of claim 1.
16. A pneumatic tire incorporating the steel belt of claim 15.
17. An apparatus for making the reinforcement ply material of claim 1, comprising an extruder and a die head into which the extruder extrudes an elastomeric material;
 - wherein the die head defines a die throat and includes a guide insert which guides the reinforcement elements into the die throat; and
 - wherein the guide insert comprises passages through which the reinforcement elements pass and which are arranged in a pattern corresponding to the arrangement of the reinforcement elements in the reinforced ply material.
18. An apparatus as set forth in claim 17, wherein the guide insert includes a passage for each set of reinforcement elements and wherein the passages are laterally spaced from each other a distance corresponding to the inter-set distance.
19. An apparatus as set forth in claim 18, wherein the lateral distance between passages is between about 0.20 mm and about 0.50 mm.
20. An apparatus as set forth in claim 19, wherein the lateral distance between passages is between about 0.30 mm and 0.45 mm.
21. An apparatus as set forth in claim 20, wherein the passages are circular in cross-section shape.
22. An apparatus as set forth in claim 20, wherein the passages are rectangular in cross-section shape.

23. An apparatus as set forth in claim 17, wherein the guide insert includes a passage for reinforcement elements and the passages are grouped in sets corresponding to the sets of reinforcement elements, wherein intra-set passages are spaced apart a lateral distance corresponding to the intra-set distance, and wherein inter-set passages are spaced apart a greater lateral distance corresponding to the inter-set distance.

24. An apparatus as set forth in claim 23, wherein the distance between intra-set passages is between about 0.11 mm and about 0.13 mm, and wherein the distance between inter-set passages is between about 0.13 and about 0.23 mm.

25. A guide insert for insertion into a die head to make the reinforced ply material of claim 1, said guide insert comprising a body and passages which extend through the body and which are arranged in a pattern corresponding to the arrangement of the reinforcement elements in the reinforced ply material.

26. A guide insert as set forth in claim 25, wherein the body includes a passage for each set of reinforcement elements and the passages are laterally spaced from each other a distance corresponding to the inter-set distance.

27. A guide insert as set forth in claim 26, wherein the lateral distance between passages is between about 0.20 mm and about 0.50 mm.

28. A guide insert as set forth in claim 27, wherein the lateral distance between passages is between about 0.30 mm and 0.45 mm.

29. An guide insert as set forth in claim 26, wherein the passages are circular in cross-section shape.

30. A guide insert as set forth in claim 26, wherein the passages are rectangular in cross-section shape.

31. A guide insert as set forth in claim 25, wherein the body includes a passage for reinforcement elements and the passages are grouped in sets corresponding to the sets of reinforcement elements, wherein intra-set passages are spaced apart a lateral distance corresponding to the intra-set distance, and wherein inter-set passages are spaced apart a greater lateral distance corresponding to the inter-set distance.

32. A guide insert as set forth in claim 31, wherein the distance between intra-set passages is between about 0.11 mm and about 0.13 mm, and wherein the distance between inter-set passages is between about 0.13 and about 0.23 mm.

33. A method for making the reinforced ply material of claim 1, said method comprising the steps of:

guiding the reinforcement elements in a path corresponding to their arrangement in the reinforced ply material; and
encapsulating the guided reinforcement elements in an elastomeric extrude.

34. A method as set forth in claim 33, wherein said guiding step comprises inserting a guide insert into a die head so that the guide insert guides the reinforcement elements into a die throat, wherein the guide insert comprises passages through which the reinforcement elements pass, and wherein the passages are arranged corresponding to the arrangement of the reinforcement elements in the reinforced ply material.